



FEDERAL AVIATION ADMINISTRATION
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January 15th, 2005

From: Aviation Maintenance Human Factors Program Manager, ATO-P Human Factors
R&D

To: Aviation Maintenance TCRG

Subj: AVIATION MAINTENANCE HUMAN FACTORS FIRST QUARTER '05
REPORT

Ref: (a) Aviation maintenance human factors execution plans
(<http://www.hf.faa.gov/maintfunded.htm>)

1) Each project is listed below.

a) An Evaluation of Broadband Applications to Aircraft Maintenance Safety

We have customized a PDA device to allow storage and retrieval of maintenance documents.

We are using task analysis, questionnaire responses, and inputs from line maintenance technicians to design and mock up customized PDA interfaces that allow technicians to remotely access information and communicate with other technicians. These interfaces will be evaluated with line maintenance technicians in Q2 and Q3.

All available information indicates the project is on track.

b) Vision Testing Requirements for Certain Persons Maintaining and Inspecting Aircraft and Aircraft Components

NASA Ames: To ensure that the psychophysical procedure of crack detection reflects the real-world task performed by maintenance inspectors, we ran 9 observers on a search task. Fifty-two crack images were presented to 7 inspectors and 2 non-inspectors. The task was to locate cracks in actual airframe images as a function of blur. We are currently analyzing these data, but preliminary results suggest that increased blur increases the number of false alarms and reduces the number of correct identifications of cracks confirming the results of the detection study.

OSU/CAMI: A scientific poster, entitled “Vision of Aviation Maintenance Inspectors,” co-authored by R Collins, G Good, J Nichols, M Subbaram, M Earley, A Schepler, V Nakagawara, and K Wood, was presented at the 2004 American Academy of Optometry Annual Scientific Meeting at Tampa, FL (December 9-12). The abstract was published in *Optometry & Vision Science* (December 2004; 81[12]:209).

An abstract, entitled “Medical Surveillance Programs for Aircraft Maintenance Personnel Performing Visual Inspection and Nondestructive Testing,” co-authored by V. Nakagawara, R. Montgomery, and G Good, was cleared by Dr. Jordan (AAM-1) (9/29). It was subsequently accepted for presentation at the 76th Annual Scientific Meeting of the Aerospace Medical Association in Kansas City, MO. The poster is being drafted.

A draft Advisory Circular on occupational vision recommendations for NDI/NDT and visual inspectors and guidance for implementing a medical surveillance program for maintenance inspectors is being planned.

Final reports will be available next quarter. Next, the sponsor, researchers, and program manager will develop a draft AC for public distribution.

c) Language Barriers Result in Maintenance Deficiencies

A complete analysis of the Asia data has now been performed and a draft written. This is being sent to W. Krebs by separate email. The report uses the scenario incidence measures, intervention evaluation and focus group data to provide a comprehensive picture of language errors and how they can be mitigated.

In January 2005 visits were made to Latin American Part 145 operators for further data collection. So far 150 participants have been run, with the total expected to reach 150 over four sites by January 20, 2005. In this phase we are testing one new intervention: partial translation leaving technical aviation terms in English. This is a technique used informally among mechanics and deserves quantitative evaluation.

Original objectives for Phase II were to:

1. Better quantify the incidence of each type of language error identified in the taxonomy from Phase I.
2. Quantify the effectiveness of representative intervention strategies to reduce language-related errors.

Deliverables were only defined by Phase II and were:

1. Our final report will provide refined estimates of error frequency, patterns of error types, effectiveness of intervention strategies and recommendations for FAA action to mitigate language related errors. We will provide a report on the activities in Year 3 on time by the end of the project period, to include the current report on all Asian sites.

Due to the researcher's inability to access maintenance facilities (current climate in aviation post 9/11), the researcher has not been able to collect the proposed data that was stated in the grant proposal. The researcher will receive a no cost extension to complete the grant by May 2005.

d) Using Technology to Support Inspector Training

Completed Beta- interfaces and coding for the following modules – Introduction, Training, Design and Analysis. Incorporated content into the afore mentioned modules. Completed first draft of accompanying audio for the various modules. Conducted testing of final Beta interface and content with industry partners. Feedback obtained on multimedia data [text information, images of structures/defects, videos, and voice over support] into the training system. Started work on organizing image database for the simulation module. Image editing work for simulation module initiated.

Researchers are currently developing and editing images for simulation module and conducting summative usability evaluations for introduction, training and design and analysis modules.

All available information indicates the project is on track.

e) An Assessment of Barriers to Implementation of Aviation Safety Programs (ASAP) in Maintenance Organizations

The primary purpose of an Aviation Safety Action Program (ASAP) is to identify and correct adverse safety events that would otherwise not be likely to come to the attention of the Federal Aviation Administration (FAA) or company management. Prior to the start of this study, there were twenty-eight air carriers with flight ASAP programs and only six organizations with maintenance ASAP programs. Since then, however, the number of flight ASAP programs has risen to forty-one and the number of maintenance ASAP programs has risen to ten. Although both ASAP programs have increased during the past year, the ratio of flight-to-maintenance programs remains steady at about four-to-one.

The second year of this project is focusing on survey data collection and analysis of sample ASAP reports. In the first quarter of FY05, emphasis was placed on scanning and archiving the 5,022 survey responses that were analyzed during the fourth quarter of FY04. Additionally, LexiQuest Mine, a text mining software, was acquired to begin text analysis of narrative safety reports, such as those

obtained from an ASAP report or an ASRS report. The results of this analysis will assist in the development of the Web-based ASAP Safety-information and Program-tracking (WASP) tool, whose development process will start in the next quarter.

LexiQuest Mine, a text mining/analysis software, is being tested for its usability and applicability as a “back-end” tool that could be used to conduct dynamic and objective analysis of a large volume of narrative safety reports. If this software is promising, it will be incorporated in the development of the WASP tool. Initial experiments show that LexiQuest could be used to map key concepts in textual data and the relative importance of these concepts as well as the interrelationships among several concepts could be analyzed.

All available information indicates the project is on track.

f) Auditing and Surveillance Maintenance Error Tool

Significant Milestones achieved:

- Conducted interview sessions with key members in the Quality Assurance and Audit departments at the FedEx facility in Memphis, TN.
- Used task analysis to identify needs for support of surveillance and inspection performance.
- Created a process measures definition document for the departments of Surveillance, Auditing, and Airworthiness Directives.
- Defining the impact variables, and other variables, to be considered for WebSAT, in association with key members in the Quality Assurance and Audit departments, at the FedEx facility at Memphis, TN.
- Presented a paper at the SAHI conference at St Louis, MO, in March 2004.
- Presented two research papers at the IERC conference in Houston, TX, in May 2004.
- Presented the research in 2 poster competitions in the Department of Industrial Engineering, Clemson University.
- Presented a poster of the research at the Clemson University research forum.
- Presented a poster at the HFES conference in New Orleans, LA, in September 2004. Published an associated research paper in the conference proceedings.
- Conducted a web-based process measures validation survey with FedEx to ascertain the accuracy of the process measures defined by the research team.
- Designed a framework for the WebSAT tool which would include the goals to be met and the functions that would be accomplished by WebSAT.
- Completed the annual report in October 2004.

- Conducted a web-based process measures validation survey with other airlines to ascertain the support for the selected process measures.
- Identified process measures using a need-metrics matrix.
- Identified the modules that will be incorporated in WebSAT.
- Started preliminary work on designing prototypes for each module using a conceptual design methodology.
- Awaiting reviews of abstracts submitted to ISAP (International Symposium on Aviation Psychology), 2005, and IERC (Industrial Engineering Research Conference), 2005.
- Awaiting review of journal paper submitted to IJAAS (International Journal of Applied Aviation Studies), 2005.

Work in Progress from January 12th – April, 2005 (The dates in parentheses indicate the deliverable date):

- Schedule a trip to a participating airline company to validate the selected impact variables.
- Conduct competitive benchmarking to evaluate metrics and establish target specifications. (February 10th, 2005)
- Develop the goals to be met and functions to be included in each module. (February 1st, 2005)
- Develop objectives for each module and sub – objectives for modules. (February 1st, 2005)
- Write a document listing the number of screens in WebSAT and their functions. (February 1st, 2005)
- Begin product map iterations. (February 18th, 2005)
- Begin screen design iterations. (March 1st, 2005)
- Make a trip to FedEx to conduct testing. (March 21st, 2005)
- Test the first set of product map iterations with FedEx. (March 21st, 2005)
- Test the first set of screen design iterations with FedEx. (March 21st, 2005)

All available information indicates the project is on track.

g) Effects of Fatigue, Vigilance, Environment on Inspectors Performing Fluorescent Penetrant and/or Magnetic Particle Inspections

The eight successful participants run in the previous quarter are being treated as pilot subjects, as we have made a number of changes to tighten the procedures. We have now run an additional 16 regular participants and the experiment is proceeding more smoothly.

We will continue to recruit and run participants throughout the coming quarter, achieving the total of 80 required by the end of May 2005.

Status of deliverables is as follows:

Phase I:

- i. Report on comprehensive literature reviews on Vigilance, Inspection, Fatigue and hours of work. Work will be completed by Jan 31 2004.
- ii. Report on findings for distribution of working times, fatigue strategies, inspection environments. Have collected data from approximately 30 inspectors, and will collect additional data from our contacts in Year 2.
- iii. Report on design of experiment and result of pre-tests. FPI simulation tested on two groups of pilot subjects, and 8 actual participants.

All available information indicates the project is on track; however the Report on findings for distribution of working times, fatigue strategies, inspection environments will be delayed.

h) Creation and Maintenance of AAR-100's Human Factors in Aviation Maintenance Knowledge Portal

The objective of this project will be to develop and implement an easy-to-use, updateable, customizable, and secure content management portal for internet and intranet use, using DotNetNuke technology. The research will be pursued over twelve months employing an integrated task analytic and user-centered software lifecycle development methodology with the following specific objectives: (1) collect data pertaining to Human factors in aviation maintenance; (2) identify an exhaustive list of usability issues related with the FAA's AAR-100 maintenance website; (3) using the results of the aforementioned activity, develop and implement a content management portal to ensure easy maintenance of the AAR-100's website.

Web-site Development

- Completed work on organizing web site
- Selected interface prototypes
- Developed and completed work on templates
- Evaluated and tested templates
- Completed dotnetnuke skins for most major categories
- Prototype website ready for testing end of January

Content Development

- Completed work on collecting technical reports based on initial outline provided
- Completed work on organizing refereed journal articles and abstracts
- Keyed over 400 refereed journal abstracts
- In the process of creating search functions for use

All available information indicates the project is on track

i) Human Factors Maintenance Considerations of Unmanned Aircraft

The “Role of Human Factors in Unmanned Aerial Vehicles” contract announcement was canceled. Work will be completed through an alternative method.

The first report will be due to AVR on December 31st, 2005.

William K. Krebs